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A LOOK AT THE MATERIEL ACQUISITION PROCESS.(U)

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The essay examined the way the US Army acquires new equipment. It focused primarily on Army programs, but did encompass the broader aspects of the overall approach used by the Department of Defense. It looked at the many problems facing the manager of a material acquisition program in assuring successful and timely development, test, production and fielding of a new piece of equipment. The author draws upon the literature and experience to identify problems in running acquisition programs and offers suggestions on

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how to improve and accelerate the entire process.

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US ARMY WAR COLLEGE

INDIVIDUAL RESEARCH BASED ESSAY

# A LOOK AT THE MATERIEL ACQUISITION PROCESS

BY

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22 APRIL 1982

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SUMMARY

This paper looks at the many problems facing the manager of a materiel acquisition program in assuring successful and timely development, test, production and fielding of a new piece of equipment. While it does not offer startling new concepts in shortening the acquisition process, it does offer suggestions on how to avoid common pitfalls in program management. An example of the 9th Infantry Division High Technology Light Division program is given within the context of shortening the acquisition cycle.

## INTRODUCTION

The purpose of this paper is to look at the way the Army goes about the business of acquiring new equipment. It will focus primarily on Army programs, but it will encompass the broader aspects of the overall approach used by the Department of Defense. I will draw upon the literature associated with the materiel acquisition process and my own experience working with several Army programs and one Navy program. I hope to be able to point out some of the problems in running acquisition programs, and make some recommendations on how to improve and accelerate the entire process.

The design, testing, production and fielding of new equipment has always received a lot of attention. Most of this attention centers on the high cost of doing business, but much criticism is directed toward the actual hardware performance and the many delays in producing it. There is a perception from the field that the overall process of upgrading Army inventories with new and modern equipment takes too long. The favorite example cited for a program being too long in delivering results is TACFIRE, a system that was highly touted over twenty years ago when most of the current group of senior officers were first coming on active duty. TACFIRE is just now in the early fielding process; the concept and design of TACFIRE has gone through many generations; it is not the intent of this paper to analyze the TACFIRE program, but, rather, to point out that it is a bit of a millstone for those of us in

the materiel acquisition business to carry about!

Under the Reagan administration policy of fiscal reductions in nearly every federal program except defense, which has received dramatic increases, attention is being paid to the high cost of doing business. The Army has been receiving the brunt of congressional criticism for its high dollar overruns on such programs as the Abrams tank, the Bradley fighting vehicles and the new attack helicopter. With the FY 83 budget proposal under close scrutiny, Army program managers are feeling the heat from the critics' fires. To put program costs in perspective, about $23 billion are proposed for spending on Research and Development (R&D) and procurement in the Army's share of the FY 83 budget (1). These dollars, directed primarily at acquisition of new equipment, represent about 39% of the total Army budget; however, when these dollars are put in the context of total proposed federal spending for FY 83, they represent only 3% of the total national budget. The entire DOD R&D and procurement programs represent about 15% of the total budget. Although the proportion of the total budget seems rather small, one should not become too complacent about the critics of defense programs.

The fact that there is an image of mismanagement associated with cost overruns and program delays is the reason that they become such easy targets for criticism. There is nothing new in the materiel acquisition program being under attack. The Hoover Commission in the 1950's paid a lot of attention to the problem of high costs (2). The Government Accounting Office (GAO) has been looking at the way DOD does business for many years, making many recommedations in the process.

Within the Army, one program in particular has received a lot of attention, the High Technology Test Bed Project of the 9th Infantry Division at Fort Lewis, Washington. The mission of the 9th Division, in

addition to its normal FORSCOM missions, was given to it by the Chief of Staff of the Army in October, 1981 (3):

> Commander, 9th Infantry Division, is charged with developing revolutionary approaches in tactics and equipment that can evolve into a new kind of division; field a High Technology Light Division by 1985.

If ever a mission was designed to stress the materiel acquisition system, the above mission must be a classic example. Within this paper the HTTB project will be given a closer look at how it is attempting to cut through the normal inertia associated with the acquisition process.

With Army programs being criticized from without for their high cost, and from within for their apparent delays in producing tangible results, i.e., putting new equipment into the hands of our troops in a short period of time, it is worthwhile looking into the entire materiel acquisition process in some detail to see where the problems are and what can be done about them. During the course of this investigation many of the new DOD initiatives (the so called "Carlucci Initiatives") to improve and streamline the acquisition process will also be looked at.

## CHARACTERIZING THE ACQUISITION PROCESS

In very simple terms the materiel acquisition process is a system wherein a need for a new piece of equipment is identified; something is found or designed to meet this need; the item is purchased or produced, and then fielded; the item is used until it is phased out by the fielding of a newer or better item. A more official terminology would describe these various phases in the life cycle of a system as Concept Exploration, Demonstration and Validation, Full-Scale Development, Production and Deployment. The various guides, directives and regulations used to describe this process are both legion and seem to be following an exponential growth curve. DOD has discovered that in just ten years (1971-1981) the number of directives and instructions related to the acquisition process has grown from 15 to 114 (4). The challenge to the program manager under fire from this explosion of written guidance is not how to do his job, but how to feel his way through a labyrinth of regulations without violating any rules. (Carlucci Initiative 14 has recognized this problem and DOD has been directed to reduce the number of directives.)

The interesting thing about the phases of the acquisition process is not how to transit successfully through them, but the psychology that is associated with how a project is viewed depending on what stage in the process it is. The psychology of the process changes with time. I would summarize it as four general questions, each of which is roughly

associated with the four formal phases of the acquisition process:

1. Will it work?
2. When can I have it?
3. What will it cost?
4. Can we take care of it?

Figure 1 shows the approximate timing of these four questions in relation to the phases of an acquisition program.

What these four questions tend to do is to prioritize effort throughout the life of a development program. They tend to narrow the field of view to what is of greatest interest at the moment, thus jeopardizing the success of the program by emphasizing a few aspects of it at the expense of others. To better illustrate what I mean, I will attempt to typify what these four questions concentrate on.

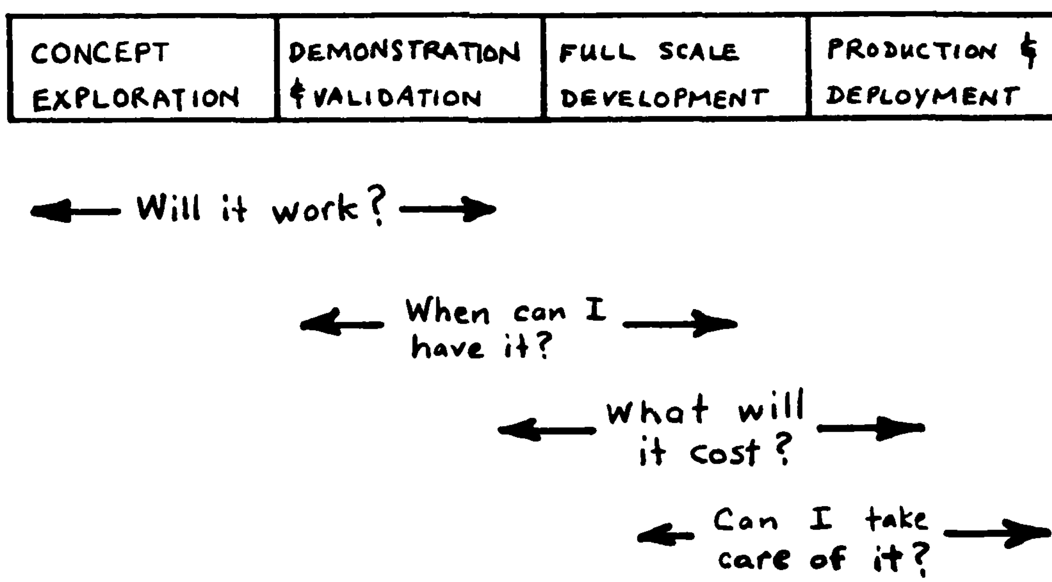


FIGURE 1

THE PSYCHOLOGY OF THE ACQUISITION PROCESS AS SEEN IN RELATION TO THE FOUR PHASES OF A PROGRAM

Will it Work?

The natural fascination with new ideas and exotic hardware always receives the most attention at the beginning of a program. There is normal preoccupation with the hardware solution to a problem. Experts abound at this stage in a program. Ask fifty colonels of infantry what an infantry fighting vehicle should look like and you will likely receive fifty very strong opinions. The technical challenge reigns supreme at this point, e.g., can we really build a main battle tank that will travel 50 mph across rough terrain? Is there an air superiority fighter that will go mach 3, have a 2,000 nautical mile combat radius, and be totally survivable? Is there a better handgun than the .45 caliber browning automatic (that will hit the target even when I jerk the trigger with my eyes closed?) and so forth. The psychology of the "will it work?" phase can best be seen in action at the annual AUSA convention in Washington, DC. Go there and you will see that the exhibits receiving the most attention - other than those with the prettiest girls or most novel trinkets being given away - are those that have actual hardware to climb on, lift, sight along, etc.

This overwhelming interest in the operational aspects of new hardware is to be expected and is in no way abnormal; however, the really pressing questions that will be asked in later phases of the program need to be looked at with much more emphasis at the front end of the acquisition cycle. If this is not accomplished with a certain amount of astuteness, the services are much more likely to be embarrassed by cost overruns, schedule delays and fielding problems that may appear after the question of, "will it work?" has been answered.

When Can I Have It?

Once a design has been successful in meeting a stated need, there is a perfectly normal shifting of emphasis and interest to the speed with which the new piece of hardware can be put in the hands of the troops. It is at about this point in the program that birth is given to that most alluring of all milestones, the Initial Operational Capability (IOC). IOC becomes very critical if the enemy threat has increased in sophistication and magnitude, and a new counter to the threat is badly needed. In terms of the formal acquisition process, concepts have been explored with promising results and the demonstration and validation of the experimental designs begin to take place. These activities require a significant increase in funds as actual hardware is being built, usually by hand and very expensively. Increased funding results in increased visibility in the budget process and, consequently, in greater interest on the part of Congress. As budget requests are made the promises of hardware performance, cost control, and guaranteed schedules begin to show up in program descriptions. The IOC takes on an almost mystic quality as program managers and legislative liaison officers attempt to convince the members of Congress and their eager, sharp-eyed staffers that here is a new system that is urgently needed, absolutely affordable, and imminently deliverable. As funding becomes available and program successes start to accumulate, there is great pressure to even accelerate the schedule to deliver earlier, avoiding costly inflation that may hit the program if it stretches out too long.

At this point, energy is focused on the timeliness of the program, since the "will it work?" question has already been answered in the affirmative. Once again, the questions that need to be asked about affordability, supportability, etc., are thought of but they just don't

have the same urgency as the question of timing.

What Will It Cost?

Up to this point in a typical program, cost has been a relatively unimportant matter. Cost levels through early R&D have been low, and, in proportion to total life cycle costs, only a small fraction of the total projected costs have actually been spent. In a recent presentation to an Army War College advanced course, Brigadier General Winfield S. Scott (USA, Retired), pointed this out graphically (see Figure 2) (5).

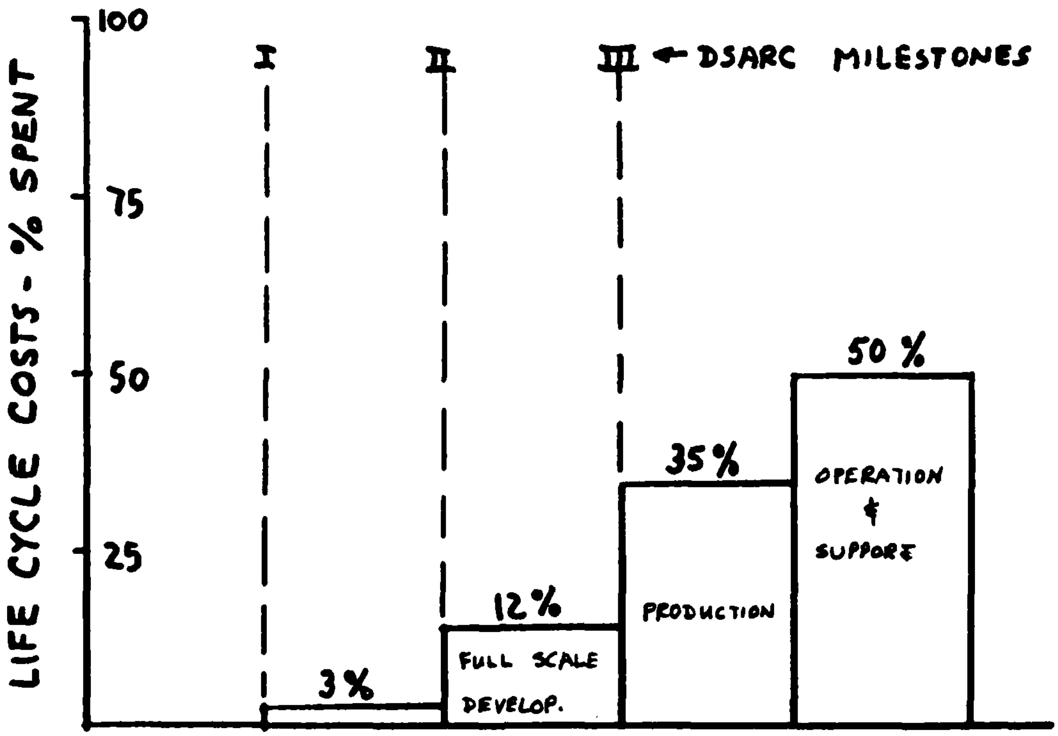


FIGURE 2

TYPICAL DEFENSE SYSTEM COST

As can be seen from the illustration, a program which has answered the first two questions of "will it work?" and "when can I have it?" has come to that point in the program where a full scale development decision is being reached, or is about to be reached. Costs will begin to increase significantly as more engineering hardware is being built and production planning becomes more intense. The schedule and IOC are still driving the program, but costs are becoming more important as they begin to show up in future projections and Five Year Programs. The contractor, because he is still in the planning stage for production, does not have a highly accurate cost estimate for production quantities. He is unable to foresee design perturbations that may have an impact on production costs; there may be a competitive development program going on, in which case there is a natural pressure to keep cost estimates optimistically low. The government does not do its part in discouraging optimistic cost estimating, for the official inflation indices that must be used to project costs into the future are always much lower than actual experience indicates they should be.

A key point about asking the "what will it cost?" question is that it has come much too late in the program. Because a project has been initiated to meet an approved need, i.e., it has passed the Milestone 0 decision point, and because a concept has been demonstrated and has proven to be valid, DOD has made a firm commitment to buy the entire program. In other words, a life cycle determination has already been made. Again, calling on Brigadier General Scott's expertise in this area (6), Figure 3 shows how cost commitments are made. Comparing this to Figure 2, we can see, in the hypothetical program being depicted, that even though only 15% of the life cycle program has actually been

spent at the DSARC III decision point, virtually the entire life cycle cost has been committed.

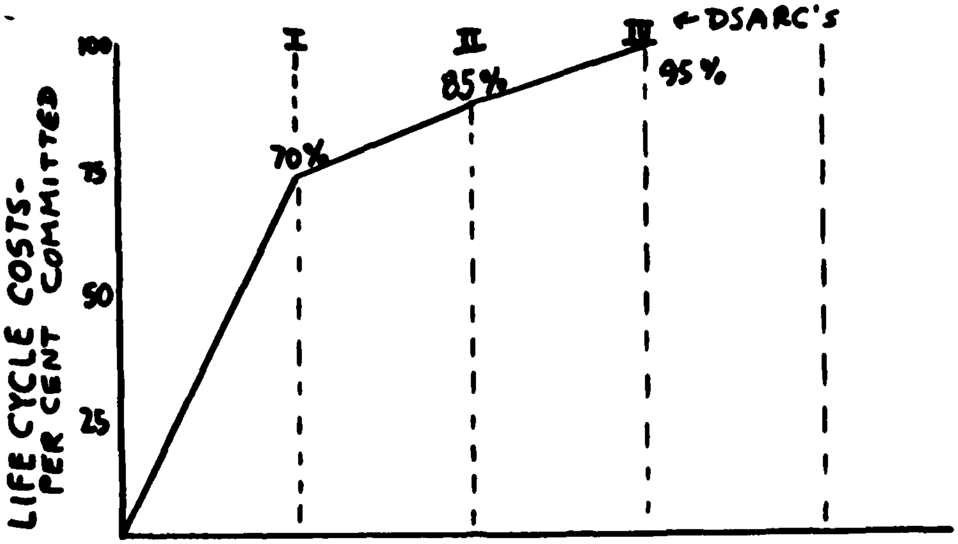


FIGURE 3

TYPICAL DEFENSE SYSTEM COST COMMITTED

Granted, a program can always be terminated, and some are, but for most programs, once they have successfully weathered a few years of challenges from the budget process, chances are they will proceed into the production phase.

<u>Can We Take Care Of It</u>?

Having fought the battles of performance, schedule and cost, a new system becomes a reality as it enters into production and hardware begins to roll out the door. The entire process of planning for the day when the first troop unit receives the new piece of equipment has been going on in parallel with the development program, but these logistics planners have been the "boys in the back room" during the more glamorous phases of the program. The Army has done much to codify and make systematic the whole Integrated Logistic Support (ILS) process, but

support packages just don't receive high priority interest when the more urgent matters of performance, schedule and cost are in their prime. The main program, i.e., the program of the major piece of equipment, drives the early decision points in the program. Although ILS is important, problems with test equipment or technical manuals are not going to influence the program until that time in the acquisition cycle when production, type classification and fielding decisions are being made. It is only when troop units are on the receiving end of new equipment that organizational structure, personnel fill and training, etc., become the dominant factors in the program. The question of "can we take care of it?" which is the last of the "Big Four" questions to be asked, is finally at the focus of attention. This question has probably been asked all during program development phases, but only in a small voice. As fielding occurs the voice becomes large and loud, especially if a million dollar end item sits idle for the lack of a $100 tool or spare part.

## HOW PROGRAMS GET INTO TROUBLE

Having looked at the psychological environment in which a program operates during its life cycle, I would like to describe how programs get into trouble, and why it is that the acquisition process, in general, is so greatly criticized. First, let's take a look at typical "complaints" about the acquisition cycle (7):

> Congress/GAO View. Services try to do too much at one time - always looking for quantum jumps in capability which cause excessive cost . . . . Early cost, schedule, and performance estimates are consistently overly optimistic and highly unrealistic . . .
>
> OSD View. Too many systems competing for scarce resources . . . . Inadequate cost/performance/quantity/schedule trade-offs during conceptual design . . . Lack of discipline of system technical requirements (gold-plating) . . . acquisition cycle too long.
>
> Service View. OSD milestone review process generates excess amount of paperwork . . . . Excessive micromanagement of program technical issues by OSD and Congress.
>
> Program Manager View. Too many reviews by too many layers in both OSD and service . . . . Too many regulations and reports .. . . Costs required too far in advance of expenditure dates.
>
> Industry View. Instability is caused by starts, stops, stretch-outs, redirections, and inordinately long decision times . . . . Over emphasis on price competition leads to lack of cost realism . . . overmanagement by the government . . . . Adversarial attitudes are held by many government personnel.

As can be seen from the opinions above, even though they are from diverse sources, they all seem to point to a complex, overly bureaucratic system that is impossible to perform under and impossible to manage. It is my experience that programs do get managed, contractors

do build equipment, and new systems do get fielded, so the acquisition process is far from being an impossible system to work under. It does take extraordinary efforts on the part of the program/project management team, good luck on test programs, and a highly cooperative government-industry relationship to successfully work a program through the labyrinthine acquisition system. Programs get into trouble for a variety of reasons. The basic acquisition system is at odds with the source of its impetus - money. Figure 4 illustrates how two massive systems are always in collision. The acquisition cycle is almost totally event-oriented. A program must successfully pass through a series of decision barriers that are almost totally dependent on successful hardware test results. A sequential series of events marks a program's progress as it proceeds through design-test-decision point from one phase of a program

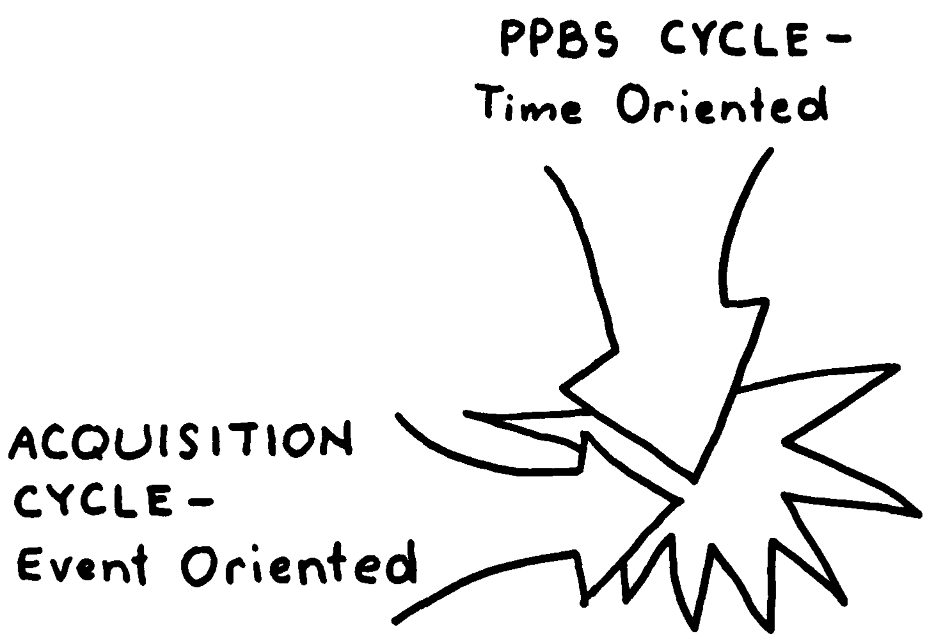


FIGURE 4

TWO SYSTEMS COLLIDE

to the next. In contrast to this chain of events is the process by which a program is fueled, namely, the budgetary process. The Planning, Programming and Budgeting System - PPBS, as it is commonly known - is one that is tied strictly to the calendar. It is keyed directly to the budget cycle which follows virtually the same pattern every year. Not only is the PPBS relentless in its course throughout the fiscal year, but it exposes major programs, i.e., programs too expensive to hide within a general funding category, to close and detailed scrutiny by Congress. Mr. Norman Augustine points out in one of his books (8) that a program must go through no fewer than eighteen reviews each year. These are reviews by different committees in the House and Senate that have a part in the overall authorization and appropriation process. It is rare that program milestones occur at points in time to conveniently justify PPBS requests for funds. The fundamental clash between the PPBS and the acquisition system is the first cause of program turbulence. Fluctuating levels of funding can only result in fluctuating levels of effort on the part of the contractor. These are the "starts, stops, stretch-outs, and redirections" that are mentioned above in the industry view of the acquisition system.

Many programs survive this funding challenge every year, but many other programs suffer because they fail to deliver on promises made the previous year. The answers to the "Big Four" questions can begin to haunt a program if there are too many unfulfilled promises on hardware performance, program schedule, cost and supportability issues. As I will develop later in this paper, I feel that the timing and sufficiency of money is the basic determinant of program success; hence, the PPBS treatment of programs is probably more important that the mechanics of the acquisition process, per se.

Taking a closer look at the acquisition process, it becomes apparent that there are three key players which I will call the program (or project) manager, the contractor, and the "system." The "system" is a nebulous, ever-changing conglomeration which includes Congress, DOD, the Service Secretariat and Staff, the Major Army Commands (MACOMs) and an amorphous entity known as "The User." These three elements, or players, must operate within the confines of numerous regulations; each element is capable of making the program go forward, languish or self-destruct. Programs most often will get into trouble when the program manager and contractor run afoul of the "system," don't understand it, or fail to "play" it properly as a program goes through its various phases and hurdles its decision points.

Early in a program, the most difficult thing to settle on is the requirement. A requirement has many forms and, over the years, the document describing the requirement has had different names. What was called the Mission Element Need Statement will now be known as the Justification of Major Systems New Starts (JMSNS). Under the Carlucci initiatives (9) the JMSNS will be synchronized with the Program Objective Memorandum (POM) each year. The birth of the acquisition process will thus be put into the PPBS, i.e., the POM input to the PPBS, when approved, will carry with that approval all of the JMSNS's that happen to be in the POM. In simpler terms, when a POM is approved, approval of its components, which include all the JMSNS's for the fiscal year in question, is automatic. This is probably the only time that the PPBS and Acquisition Cycle are together! Once the JMSNS is approved the program manager has in hand his requirement to launch a new program. Ideally, this requirement is so well written, so current with the state

of the art, and so precise, that the rest of the acquisition process falls easily into place. Unfortunately, the requirement is often a vague attempt to describe something that has yet to be proven. More often, a requirement and its related design concepts interact in such a way that they are not sequential activities within a program. Requirement definition and R&D are often collateral activities. As hardware designs are subjected to management reviews, congressional scrutiny, and a constantly changing array of personnel representing "The User," the requirement has a way of becoming a fleeting concept, always evolving into something a little different from the original idea expressed in the JMSNS. All three elements (program manager, contractor, and the "system") have a hand in changing the requirement. The manager may want to change things to meet schedule and cost problems; the contractor may want to change things because he just can't meet every part of a requirement, e.g., a weight limitation may limit required armor protection; the "system" will change requirements because there is a revised threat, or a new administration, or new people in key staff and leadership positions. The challenge of stabilizing the requirement is the first one that must be met by a program if it is going to operate with minimal difficulties within the acquisition process. There is no simple way to meet this challenge of the "changing requirement," but, in the next section, I will make suggestions on how some of the turbulence can be reduced.

Another source of delay is the failure to recognize the administrative lead time associated with various key events in a program schedule. This will result in severe delay for both the contractor and the program manager if they are not recognized early enough to allow for sound planing of activities. I will look first at the contractor's

point of view, and some of the problems he faces in traveling through his network of contractual milestones. To illustrate an example of this, Figure 5 shows a hypothetical, but not unrealistic, period in a program's development cycle. A typical project will require the contractor to design and build hardware for testing. The contractor would want to do some of his own testing on the design to assure himself that the design concepts will work. Following the contractor tests, the government would normally test. For the Army, this would either be Development Testing (DT) conducted by the Test and Evaluation Command (TECOM), or an Operational test (OT) conducted by the Operational Test

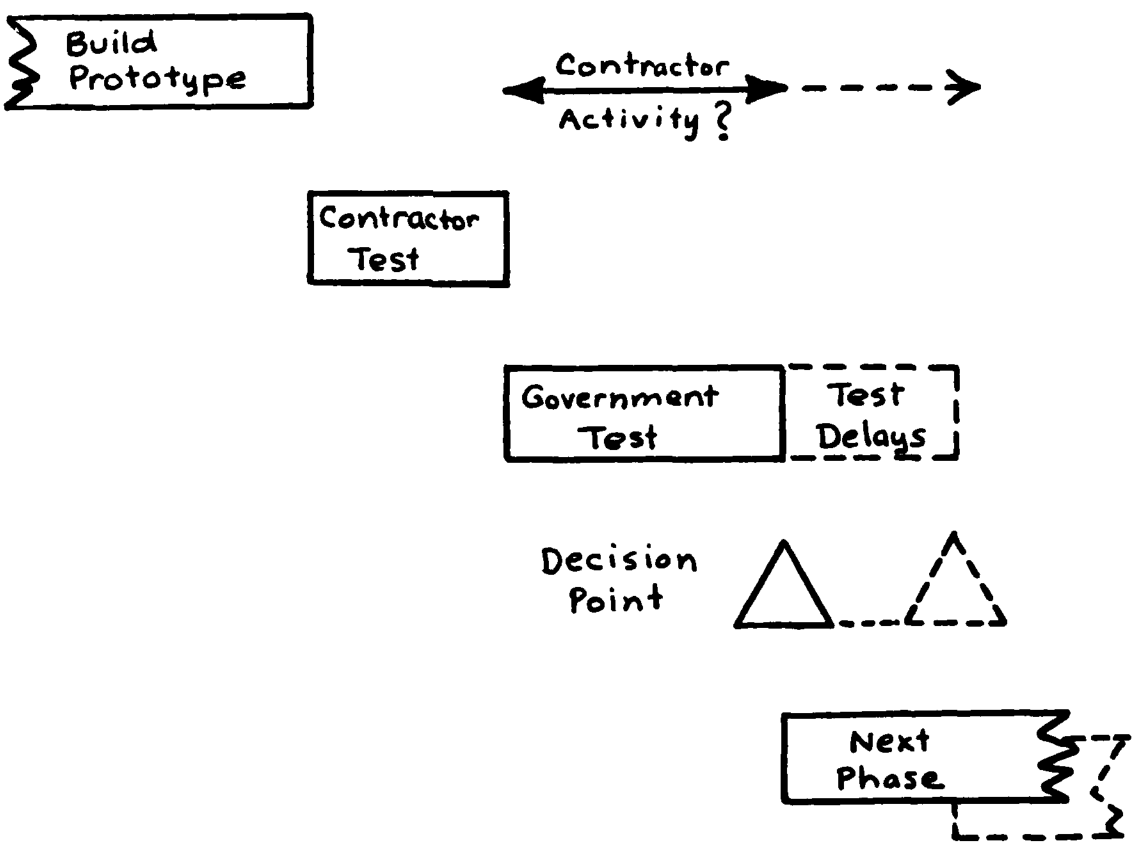


FIGURE 5

A SEGMENT OF A PROGRAM SCHEDULE

and Evaluation Activity (OTEA), or, perhaps, a combined DT/OT. A program schedule would normally show these activities culminating in a simple tick mark on the schedule representing a major decision milestone, e.g., ASARC II. There are two problems with this type of scheduling: one has to do with contractor workloading, and the other has to do with trying to compress several months of activities into a single point on a program schedule. I'll call this latter problem the "tick mark syndrome," which I will discuss later. First, let's look at the contractor's problem.

During a development contract the contractor will assign design engineers, technicians, etc., to a program in numbers sufficient to accomplish the required tasks on time. Chances are he will be working on a cost reimbursable type of contract, so he has no strong incentive to keep his work force lean. Since the contractor is in an R&D stage, the same engineers and technicians involved in the design would probably work very closely with the actual fabrication of the item, and would then work with the test programs. This is normal activity for a development effort, and the contractor has no real problem assigning personnel to the project. As the government testing begins, however, contractor manhours should decrease, because there isn't as much contractor support required. The question now facing the contractor is one of personnel placement. What does he do with his project team while he is waiting on a government decision to proceed? A large contractor with many programs has some degree of flexibility in assigning his personnel to other contracts he may have in progress, or, to a limited extent, may be able to place a few of his personnel on overhead. Since overhead rates are closely audited by the government, there is a practical limit, as well as a legal one, as to the number of personnel that can be

assigned overhead tasks. The government makes a mistake if it assumes that a contractor can cope with large fluctuations in manpower requirements without causing future problems in the program. In severe delays where the contractor has to wait several months for the next phase of the program to move ahead with new funds and a new contract, he may be faced with having to lay off some of his program team - he simply has run out of options. It is true that the government can take a very narrow view of this problem, i.e, the contractor is in the business to take risks, and the government certainly has no obligation to keep a contractor's work force employed at a certain level. On the other hand, the government program manager should not expect a contractor to start right up with the next phase of the program without delays. The contractor will have to build up his team again, or even train new personnel if some of his original team has found employment elsewhere. There are ways to avoid this problem which I will outline in the next section of the paper.

A more serious aspect of the potential delays in a program are those caused by poor management on the part of the program manager and the "system." Again, referring to Figure 5, it can be seen that a major decision point is almost totally dependent on a program event; in the case illustrated, the event is a test. A test, with luck, can go fairly well, but the documentation associated with the test can take some time to put together. If a program schedule fails to include sufficient time for a test report to be written, coordinated and published, not only is the decision milestone held up, but the contractor's work load problem is exacerbated even more as he waits for the next phase of the program to get underway. It is very easy for a program milestone to change from

a single point in time to a stretched out segment in the program schedule. An event thought of as a tick mark is now a bar on the graphical representation of the schedule. This "tick mark syndrome," as I called it earlier, can be particularly active where program phase changes revolve around some contractual procurement action. Figure 6 shows another example where a tick mark, i.e., major decision point, is dependent on many interrelated activities. Perhaps one of the more difficult milestones to get through is selecting a single contractor to proceed with a program that has involved two or more competing contractors in the development phase. The competing contractors have submitted

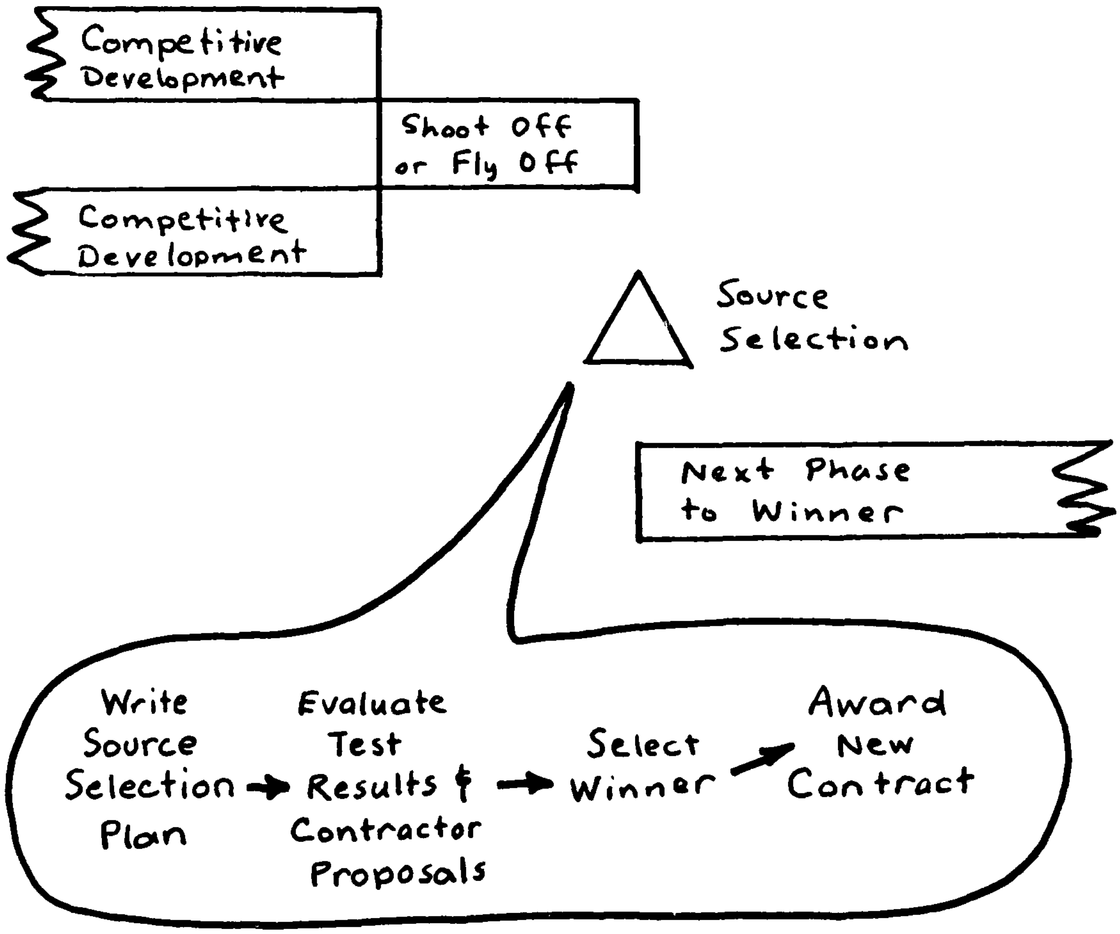


FIGURE 6

ILLUSTRATION OF "TICK MARK SYNDROME"

rival designs to a "shoot out" or "fly off" of some sort where both designs have been subjected to the same test. Along with test results the contractors would normally be required to submit detailed proposals for the next phase of the program. In the case illustrated, not only is the program vulnerable to test report delays, as shown in Figure 5, but the entire source selection process can take months to complete. If a program manager has been carrying this part of the program as a tick mark milestone, he will very likely be dismayed when he realizes all the lengthy processes that must occur, usually in sequence, before he can move on into the next phase of the program. As Figure 6 shows, source selection involves the writing of a plan (that must go through its own approval cycle), the evaluation of test results and proposals by a large, unbiased team - the source selection team - the selection of a winner (also required to be approved, and also subject to protest action on the part of the losing contractor) and the negotiation and award of the next contract to the winner. All these activities are complex and take time. The entire source selection process can take as long as six to nine months. Much of this time can be decreased through careful planning, but all sorts of problems can be avoided if the program schedule is well thought out and recognizes that many activities cannot be portrayed as simple tick mark milestones on the program schedule. There are many opportunities throughout the life cycle of a program where the dangers of "tick mark syndrome" can be recognized and avoided. This, in turn, will help alleviate the problem of promising an overly optimistic IOC date. Again, I will expand on recommended solutions to some of these problems in the next section.

Another major area where I can see programs getting into cost, schedule and supportability difficulties is that of complex ancillary

programs that must run concurrently with the primary hardware program. These ancillary programs are numerous, and each breeds its own cult of experts who place demands on the program that must be dealt with. Three major programs, which I'll call the "monster programs" are the Test Program, Integrated Logistic Support (ILS), and the Training Devices Program. (Technically, training devices are a subset of ILS, but they can be too costly and too complex to hide under the ILS blanket.)

The Test Program.

As has already been shown, testing is critical to a program's success or failure, because test results are used to guide a program through its major decision points. In fact, most large project offices will form a test branch very early in a program's life cycle. The greatest challenge for a test program planner is to be able to understand and define design requirements in detail and to translate these into test plans that can be implemented and agreed to by the contractor. Nothing will unnerve a contractor faster than to require him to contractually commit himself to achieve design requirements that must meet nebulous testing parameters. Even the most simple requirements and specifications can lead to ambiguity. For example, let's say a system must meet certain physical dimensions. Do these dimensions include detachable items such as antennas? Does operating weight include all consumable supplies and personal equipment of the crew? Under what conditions must top speed be achieved? And so forth. If a contractor and the program manager don't have a firm agreement on what is to be tested, and how the results are to be interpreted, there is no end to the possible schedule slips and cost overruns that can occur.

The number of tests a system is required to go through if it is

following a standard development plan is great. Each milestone is coupled to a DT/OT requirement; these tests may generate follow-on test requirements if the hardware does not do well, or design changes are significant enough to require separate testing. The DT/OT cycle describes only the formal TECOM or OTEA involvement in testing. Hidden within the system specification is an additional family of tests associated with the "-ilities," e.g., maintainability, reliability, availability, environmental tests and so-called shake-rattle-and-roll testing. All this testing is meaningless if there isn't early agreement - spelled out in the terms and conditions of the contract and the technical specifications - on how tests are to be run and how the results are going to be used to determine whether or not the contractor has met his requirements. Even though a system may go through severe testing and either passes or has design modifications made to correct test failures, there always seem to be a number of early failures when a system is fielded. If these failures are numerous and widespread a new system can very quickly acquire a bad reputation which it never can live down. Why is it that a well tested system can develop new problems once it is fielded? I attribute this primarily to the kid-glove treatment a system is apt to receive during its formal test program. A typical complex system will have its crews handpicked from FORSCOM units. These soldiers will be sent TDY to the contractor's plant where they will be put up in a local motel, generally wear civilian clothes and enjoy a very intense level of personalized training. Their instructors are highly qualified design engineers or technicians who know every idiosyncrasy of the equipment they are working with, including all the tricks used to fix the equipment that aren't published in the draft technical manuals. This highly select crew is then used to test the

equipment under government supervision. Whether it is a conscious effort on the part of the crew, or not, is debatable, but, whatever the reason, test systems receive better treatment than the actual system will when it is fielded. Even though crews from the units receiving the equipment undergo extensive new equipment training, it just does not meet the level of sophistication experienced by the original factory trained test crews.

To counter this problem of the highly trained test crew being used to validate system performance it would be tempting to do more testing with regular troop units operating the equipment under the more realistic conditions of everyday operations. The problem with this approach to testing is that it becomes very difficult to perform failure analysis, e.g., how is the design engineer to know if his design was weak or if the equipment was abused by improper operation or maintenance? There is no clear solution to the test problem. What is clear is that a poorly defined test program can lead to catastrophic problems from contract disputes to bad press or congressional criticism.

Integrated Logistic Support.

In the long run, ILS is perhaps the most critical of all the program factors influencing the success or failure of a program. A new system that is fielded without adequate support does not meet its requirements, even though its design parameters may have been met. ILS is the most difficult aspect of a program to execute properly. Early in this paper I mentioned the psychology of a system's acquisition life cycle: the very last question people ask of a system is, "can we take care of it?" The literature associated with ILS has increased exponentially over the past few years. ILS as a concept first appeared in

the 1970's; its various components are many and complex. The most recent guide (10) lists these elements of a complete ILS program:

- The maintenance plan
- Manpower and personnel
- Supply support
- Support and test equipment
- Training and training devices
- Technical data
- Computer resources support
- Packaging, handling, storage and transportation
- Facilities

The failure of the program manager to execute any one of these elements properly can completely stifle the initial fielding of new equipment. A million dollar tank can very quickly be deadlined for the lack of a $1,000 piece of test equipment. Each one of the ILS elements has its own experts and advocates and its own set of agencies that must be involved. The task of adequately planning and coordinating the effort is monumental. What makes the task nearly impossible to do perfectly is the fact that ILS is not a sequential event in the acquisition process, but it pervades the entire life cycle of the system from its initial conceptualization to the end of its useful service in the inventory - cradle-to-grave, as it is often expressed. Ideally, a logistics engineer would like to have the time to derive his ILS elements from a hardware design that is firm and has been successfully tested. Figure 7 shows this ideal process graphically. The ILS manager, working from design drawings and prototype hardware, would develop his manuals, special tools, spare parts requirements, etc., and then test all these items in a system that approaches the actual production design.

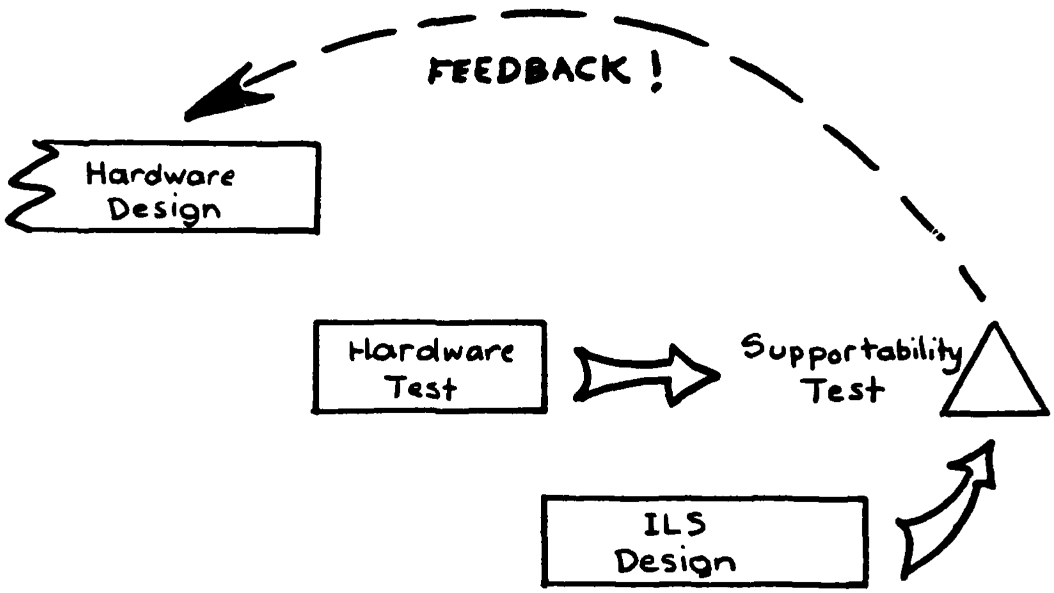


FIGURE 7

THE IDEAL ILS PROCESS

Problems in maintainability would then be fed back into the design department so that appropriate adjustments could be made. This is a nice leisurely process designed to give the ILS manager time to develop his products from a reasonably firm data base, test them, and influence design changes before the final design is commited to production. Unfortunately, there are two major drawbacks to this ideal program. First of all, there just isn't enough time in a program to allow this sequential development of ILS; secondly, by waiting for the design to be completed, the maintenance engineer misses the opportunity to change the design early to make it more maintainable. The problem of the ILS manager is to work in parallel with the design engineer so that both products are completed at about the same time and can be tested

together. In fact, this parallelism is the very nature of textbook ILS - a continuous process that, in theory, results in a complete and supportable piece of equipment that meets all its requirements when the IOC is achieved. In practical terms, an ILS program cannot be developed simultaneously with the hardware program. As a system matures, more and more of the ILS documentation is developed, principally in the form of technical manuals, tool lists, spares lists, etc., which require more and more time and effort to change every time a hardware change is made. In today's climate of the "comic book" tech manuals there are literally tens of thousands of pages associated with a complex system, such as a fighting vehicle. It becomes nearly impossible to manage change in a timely manner; yet, if this is not accomplished, supportability becomes a major issue. A poor ILS program can seriously degrade the overall success of an acquisition program, and cause many delays which translate directly into increased funding requirements, i.e, cost overruns.

Training Devices Program.

Training devices are listed as an element of ILS; however, they have become such significant programs in terms of importance and dollars, that they deserve the prominence as one of the "monster" programs. Training devices have their own set of regulations, doctrine, and agencies associated with them. The timely development, production and fielding of training devices will enable TRADOC or the field commands to conduct realistic training without having to tie up millions of dollars worth of actual operational hardware. Delays in fielding training devices can divert resources needed for the end item they are designed to support, and can cause delays in fielding of the end items because of a lack of trained crews. The manager of the training devices program

must develop his system in parallel with the primary hardware, but, as in the development of other ILS items, must wait for the hardware design to evolve before he can analyze training tasks, levels of performance, density of training equipment and so forth. The training device development, as a very important part of the acquisition process, can very easily contribute to overall system problems if it is not carefully managed throughout the various phases of the system life cycle.

## INFLUENCING THE ACQUISITION PROCESS

We have seen, in the foregoing section, many opportunities for the acquisition process to run aground, suffer delays and overrun costs. There are so many examples of programs that have various combinations of these problems that it is very easy to be critical of the materiel acquisition process in general. Invariably, a program that has problems, will incur delays; delays cost money; increased costs are met with resistance and often result in decreased production quantities; decreased production quantities drive cost per unit up. The final result is the fielding of a system that is long in coming and terribly expensive. How can these problems be avoided? What can be done to overcome these problems? Is the acquisition process itself at blame, or is it just a convenient scapegoat? I don't know if I can answer these questions in an absolute manner, but I will attempt to offer some insight into possible strategies and solutions that will minimize some of the potential problems a system can experience.

The first generalized problem I discussed, the psychology of the "Big Four" questions, is probably the most difficult to overcome. It takes a farsighted management team to look 8-12 years ahead and plan for all the challenges that will arise. Yet, for a program to be successful, all the challenges must be met early in the program. Realistic cost estimates and scheduling and early funding of a program are keys to success. In fact, throughout this section, I will tend to force my view

that adequate and timely funding, coupled with sound planning, is the fuel of program success. The acquisition process, though difficult and complex, is nothing more than a common sense sequence of events designed to cover all elements of a program. Much can be done to remove or decrease irritants to a program; this is exactly how I view the Carlucci initiatives: they are designed to decrease external requirements on the program manager - and also give him more authority - so that he can devote more time and energy to actual internal management problems than to external pressures.

Probably the most important aspect of program stability early in a program development is to insist on a firm requirement. If the user, or army hierarchy, or Congress tinkers with or modifies a requirement, an immediate cost and schedule impact must be made known to the decision authority involved in changing the requirement. There is nothing wrong with modifying a requirement for legitimate reasons, but it is absolutely critical that changes be controlled and recognized for the turbulence they can cause. The Bradley Fighting Vehicle is a good example of a system that has undergone significant requirement changes throughout its development cycle. Because the current configuration is quite a bit different than earlier concepts, costs have increased considerably over early estimates; however, it is very unfair to compare today's costs with yesterday's original requirement and attribute the difference as a cost overrun and a case of mismanagement. When tradeoffs and compromises are made they must be thoroughly documented and made known to every management level.

The "tick mark" syndrome is a little easier to overcome than some of the more difficult problems discussed above. Almost every major

program milestone revolves around a procurement action of some sort, i.e., a contract award, a contract modification, or the issue of a Request for Proposal, etc. The Defense Acquisition Regulation (DAR) is so complicated that even the most simple requirement can require hundreds of pages of contract documents. Good planning can alleviate some of the lead time problems, but it must be remembered that both the contracting officer and the contractor need adequate time to respond to requirements. One good technique to reduce procurement lead times is to execute the original contract package with several contract options so that when it comes time to move from one program phase to another a contract option is exercised, a simple contract modification is negotiated and the contractor can proceed without a loss of continuity in his work load. It must be remembered that major program transition points, e.g., source selection, or initial production, take a massive procurement effort. Program schedules should recognize this early in the program life cycle so that testing dates and IOC's don't crowd procurement actions with unrealistic starting points.

The converse to this problem of trying to condense a program too much is allowing a program to have gaps in it so that the contractor is unable to stabilize his work force. Again, sound planning is the key to avoiding this problem, and some foresight in procurement strategy and contract writing will allow the contractor to be funded during major program transition points. If this isn't done, and the contractor is forced to transfer or lay off some of his personnel, more start up time will be required by the contractor at the beginning of a new phase. There is much effort than can continue on during these program lulls, particularly in testing and ILS programs. The program manager should look to these ancillary programs as a means to keep a reasonable work

load on the contractor.

Once a production point is reached, multi-year funding is a powerful tool to keep the contractor flowing smoothly. An early commitment on the part of the government allows the prime contractor to make early commitments with his vendors and sub-contractors, thus resulting in a more economical business arrangement. Multi-year contracts must allow both the contractor and the government some flexibility. If problems should arise and hardware modifications are needed, there must be some way to contractually protect the interests of both parties.

Sometimes the "tick mark syndrome" is directly related to an urgen program action. Such is the case of the Required Operational Capability (ROC) document. It is very tempting to indicate a ROC as a single point on a program schedule. A careful look at the Material Acquisition Guide (11) will show that the ROC process takes about six months. Figure 8 shows this in detail. It can be seen that

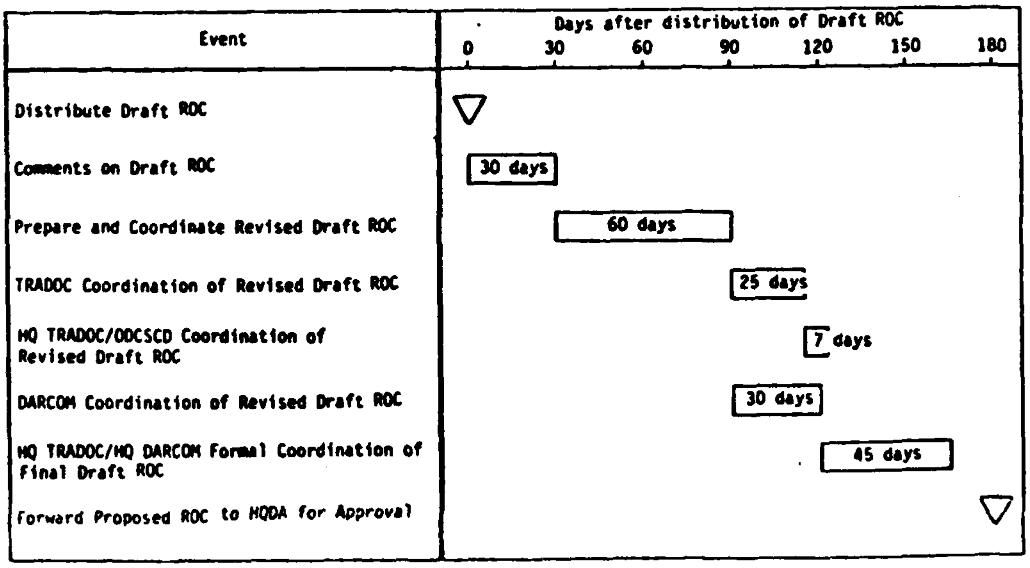


FIGURE 8

THE ROC PROCESS

time is spent in coordinating the draft between two major commands, TRADOC and DARCOM. The 9th Infantry Division has discovered that this process can be shortened dramatically by causing the appropriate personnel to sit down together and hammer out the basic requirement, agree on it, and get it back into DARCOM channels so that the appropriate action can be taken on it. The 9th Division has used the term "mini-ROC" to describe this process. This technique will shorten a six month process into a few weeks. There are similar opportunities throughout the acquisition process where long delays can be avoided by condensing the amount of time it takes to process major program documents. The ultimate key to successfully shortening the generation of these documents is to have the Department of Army Staff fully attuned to what is going on so that, when DA approval is required, it comes quickly and without problems.

Dealing with the three "monster programs" in such a way that the overall program schedule is not slipped is much more difficult. These programs must be concurrent with the hardware program in order to shorten the overall acquisition time; however, so much of the testing and ILS is dependent on early identification and control of the hardware configuration, it becomes very costly to keep up with engineering changes. This effort must be accomplished if schedule delays are to be avoided. The only way to do this is to adequately fund these "monster programs" early in the program life cycle so that schedule and cost turbulence are minimized. Training device problems can be avoided if early planing is made for the use of operational hardware to support the training of initial crews. A slow, phased fielding program will also reduce the impact of unforeseen problems. The most important thing to keep these problems from blossoming into massive cost overruns is to realisitcally plan schedules, and fund early. It is much better to

fight funding problems early in the program than to underfund program elements only to have them appear later as overruns amidst the charges of "mismanagement."

## CONCLUSIONS

As a result of this look at the acquisition process, I arrive at the conclusion that there is nothing basically wrong with the framework of the materiel acquisition process. It is, perhaps, complex and overly regulatory in some respects, but its primary function, that of mapping out an acquisition strategy, is basically sound. The problem is to know how to operate successfully within this environment. Personnel turbulence leads to many problems because key decisionmakers who initiate programs are normally long gone by the time a new system is ready for fielding. A carefully documented program that enjoys hardware successes can normally survive the many problems it will encounter along the way. A sound government-industry relationship, detailed planning, and early funding appear to be the main ingredients for keeping a program on track. Essential tasks that are put off early in a program will always come back to haunt the program later.

Finally, a program or project manager who has the respect and confidence of his contractor and the backing of his superiors, can overcome nearly every obstacle by shear dint of effort and extraordinary energy. The constant selling of the program, the formulation of a government management team, lots of money, and a little luck will allow a system to wander through the acquisition labyrinth with minimum delays and moderate or no cost overruns.

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